The inert character of glycerine jelly, so well-known to microscopic mounters, justifies confidence in its stability. A large proportion of glycerine may render certain objects too transparent. This tendency may be corrected by changing the proportions as required, or by adding alum. I have found even delicate colours, such as those of squids, readily preserved by the jelly. No effusion of mucus or colouring matter takes place, and an animal may be mounted fresh if care be taken that the jelly penetrates sufficiently into cavities of the body. Previous immersion in alcohol, or other preservatives, does not prevent re-mounting in glycerine jelly. Many of the ordinary reagents used by the histologist may be added to obtain special results. I have not as yet succeeded with large objects, but mountings with as much as a pint of jelly have done well.

The cost of the jelly is not prohibitive, and when the freedom from loss by evaporation, or spoiling by turbidity and discoloration is considered, this mode of preparation will be found cheapest in the end. Harvey and Reynolds, of Leeds, undertake to supply the undilute jelly at a moderate price.

Until experience suggests improvements I have nothing to add. The preparations ought to be kept for years before the new process can be recommended in unqualified terms. I think, nevertheless, that I have already seen enough to warrant the anticipation that mounting in jelly will for certain purposes displace all the fluid methods in use. L. C. MIALL

Leeds Museum

BEES

AN American correspondent writes asking Mr. A. R. Wallace, through NATURE, his opinion as to the genus *Apis*. Are *dorsata*, *zonata*, *indica*, *adansoni*, *nigro-cincta*, and *florea*, each or all distinct species? or, our correspondent asks, are some of these like *ligustica* and *fasciata*, simply varieties of *mellifica*? Also as to structure and habits of *A. dorsata* and others, which Mr. Wallace has personally seen and handled.

The following reply has been sent us to these queries :—

Mr. Alfred R. Wallace having suggested that I should answer the queries of your American correspondent, I do so at once, having in the year 1865 published in the *Annals and Magazine of Natural History*, a somewhat elaborate paper on the subject on which information is sought for. The species that in my opinion are distinct are *Apis mellifica*, *A. adansoni*, *A. dorsata*, *A. zonata*, *A. unicolor*, *A. indica*, and *A. florea*. I do not consider the examination of worker bees only sufficient material to enable any one to form a decisive opinion as to species; the examination of drones, also, I consider indispensable; it is advantageous to see queens, but those which I have seen do not present any very marked peculiarities indicative of specific distinction. I possess males and workers of *A. dorsata*, *A. indica*, and *A. florea*. That *A. ligustica* and *A. fasciata* are climatal varieties of *A. mellifica* has been apparently proved by the fact of their having in England reverted to the original stock, *A. mellifica*; there is, however, a remarkable fact to be noticed that, notwithstanding the change referred to, they still possess a much greater degree of irascibility than *A. mellifica*; *A. fasciata* undoubtedly in the greatest degree. I consider *A. zonata* distinct from *A. dorsata*, its nearest ally; it is a larger bee, jet-black, with snow-white bands on the abdomen; I have not seen *A. dorsata* from Celebes, where *A. zonata* was discovered by Mr. Wallace, but he found that species in Sumatra, Flores, Timor, and Gilolo. *A. adansoni*, and *A. nigro-cincta*, will probably prove to be climatal varieties of one species, the latter being a pale form with dark bands. There is no doubt of *A. indica* being a distinct species, all the sexes are known, and there is no other species found in India with which it could be assimilated. Of the specific distinction of *A. florea*, the remarkable structural formation found in the drone, that of a lobe on the metatarsus, is conclusive; it is also much the smallest species known of the genus Apis. *A. unicolor* inhabits Madagascar, Mauritius, and the Island of Rodriguez; a considerable portion of a swarm was obtained from the latter island, an examination of which inclines me to consider the insect much more than a climatal variety of any other species; it remains that the drones and queens should be obtained in order to decide the question; until this can be effected I shall consider *A. unicolor* a good species.

Of the habits of the species of the genus Apis, Mr. Wallace, Sir John Hearsey, Dr. Jerdon, and Mr. Chas. Horne have given some interesting particulars. *A. dorsata* suspends its mass of combs on the branches of trees, quite exposed, having no covering whatever; Sir John Hearsey succeeded in obtaining a swarm which he secured in a box-hive, thus domesticating the species, and obtaining from time to time quantities of delicious honey. Dr. Jerdon gave me combs of *A. indica*, which had taken up its abode in the rafters of an outhouse. Mr. Horne gave me the comb of *A. florea*; it is attached to a twig of some bushy plant. Dr. Welwitsch brought combs of *A. adansoni* from Angola; they were found inside a hollow tree; the cells are considerably smaller than those of any of the honey-bees of Europe. FREDERICK SMITH

British Museum

THE ORION NEBULA

A SHORT time ago we gave an abstract of d'Arrest's "spectroscopical researches." The Danish paper contains also the conclusions at which he arrived after many years contemplation of the nebula in the sword-handle of Orion. The spectrum is now easily visible, with open slit, even without a telescope. Then we see three images of the nebula corresponding to the three lines, whose relative intensity d'Arrest found to be 100, 24, and 71. To see the fourth line is of course very difficult. If the spectrum of the stars is looked at together with that of the nebula, we find the nebular lines continue absolutely unimpaired through the inner trapeze. Consequently it cannot be considered as proved that the stars are in connection with the nebula. It has not, of course, yet been possible to ascertain spectroscopically whether the stars are nearer to us than the nebula, or farther away in space. The question of resolvability has lost a good deal in interest since Huggins showed its gaseous nature. However, d'Arrest would not believe that it had ever been resolved into stars in any of the large telescopes of his day. All the more startling was the Rev. Dr. Robinson's letter (NATURE, vol. xv. p. 292), that he as early as 1848 had resolved this nebula with the Earl of Rosse's telescopes. It would be worth while for Mr. Ellery, who, according to our astronomical column, is investigating the southern nebulæ, to ascertain whether actual resolvability is referred to here, or the circumstance that, as might be expected in so enormous a reflector, a good many small stars become visible by glimpses. Liapounov describes the appearance of Regio Hugeniana as follows: "Ces masses m'avaient présenté à plusieurs occasions des ressemblances frappantes avec des amas d'étoiles. Le caractère stellaire s'est prononcé d'abord dans la masse la plus lumineuse, dont l'apparence me conduisait depuis constamment à l'idée d'une agglomération de petites étoiles condensées." We are hardly right in concluding that the nebula could be resolved in the nine-inch refractor of the Cazan observatory.

The Orion nebula was first pictured together with the four stars of the trapeze by Huyghens, who discovered it in 1656, though Cysat referred to it already in 1618. It was afterwards examined by Derham, Godin, Fouchy, Mairan

and Picard. Legentil compared its outline to that of the open mouth of an animal. Messier was the first who gave a catalogue of the stars seen in the nebula. Schröter, in Lilienthal observed it, 1794-1799. It was this eminent astronomer who discovered that this chaotic mass is not in perfect equilibrium, and several of the changes he pointed out have been verified by modern observers. Sir W. Herschel watched the nebula during thirty-seven years. He believed that changes were taking place in Nebula Mairani. The most important fact connected with the discovery of changes was, that the three conspicuous stars ϵ, ζ, and η (J. Herschel, 1825), in most of these old maps, are represented as inside the bright nebulosity, while they are now seen far from it. D'Arrest showed that no changes have occurred here by aid of a drawing, which Lefebvre published, 1783, in Roziers, "Observations de la Physique." He also remarked the characteristic circumstance that in this figure Sinus Magnus is represented as running right across the trapeze, which, in consequence, is lying altogether outside the nebula. Lefebvre's drawing is, however, executed in the style of those that preceded Messier. It is of uniform brightness and sharp outlines.

Sir J. Herschel appears to have been the first who understood that in order to ascertain changes, it was required to give faithful drawings of all the minute parts of the nebula. His first drawing was executed in 1824, and that was, in 1847, followed by the beautiful figure founded on micrometric measurements made at the Cape, 1834-1837. He attributes hardly any weight to the first drawing, which had been made with freehand, compared with the last one.

Lamont published, 1837, an image of the brightest part of the nebula which Herschel criticised. He found, for instance, Regio Hugeniana more uniform, and marked with certain channels, while Lamont represented it as consisting of rounded masses running into each other. Later authorities agree with Herschel, but it deserves to be remarked that he had not himself, 1824, remarked these channels, nor are they laid down on Cooper's map. It so happens that the refractor in Copenhagen is exactly similar to that in Munich, and in consequence a comparison of the respective drawings made at an interval of thirty-five years could not but be of importance. There is no trace of the sharp outline in the north-west corner, which the Danish drawing shows, and it is so much more likely that here great alterations in brightness have taken place, as all the old drawings, for instance Cooper's, support Lamont, while the later ones in this respect agree among themselves. Amongst the most remarkable differences d'Arrest classed Pons Schröteri in Sinus Magnus. Lamont has of this bridge only the small piece, which, like a promontory, is attached to the north side, while d'Arrest saw the brightest patches about midway. On the above-mentioned old drawing by Cooper, Pons Schröteri is only represented as three small pieces emanating from the north side, while the same is now in the large refractor of the Markree Observatory only noticed as a little spot in the middle of the bay. Such changes were already alluded to by Schröter, and modern diagrams support this hypothesis.

Liapounov's diagram, drawn after most careful micrometric measures,[1] represents the object as seen about 1850. He agrees with Lamont about Regio Hugeniana, and also about the east point, which he found well defined against the far fainter Proboscis Major. He observed Sinus Lamontii, which he surrounded by the bright nebulosity, since called Hemicyclium Liapounovii. The darkness of this Sinus varied considerably, and thus it was explained why it was not noted by Herschel, though indicated on Cooper's map. Liapounov represented Pons Schröteri as emanating from the north side of Sinus Magnus, but he made it end with a bright spot, and his representation is, therefore, the midway between older and later drawings. Few astronomers have conducted similar researches so earnestly and faithfully as the Russian professor, and his merits have not been so highly appreciated as they deserve. It appears to me that this is even the case from the side of his Danish colleague.

Lassell published in 1854 a steel engraving, which was badly executed, the regions round Sinus Magnus in particular. Nebula Mairani was made brightest of all the nebulæ, while it only holds the third or fourth place. All these drawbacks have, however, been removed from the second drawing made in Malta, 1862 and 1863, which is one of the best extant.

The drawing Secchi published in 1868 is not to be trusted, and even the central region is wrongly drawn. D'Arrest had made a similar remark about an earlier figure by Secchi, to which the Papal astronomer answered: "Che la figura litografica pubblicata, benchè esatta in generale, ha alcune inesattezze non trascurabili." The possibility of a similar explanation in the present case was excluded by the remark: "Cosi siamo sicuri che l'incisione rappresenta la nebulosa come vedesi da noi nel nostro strumento."

George Bond's drawing, of about 1860, is in d'Arrest's opinion, more like the nebula than any that has been drawn from a refractor, and the characteristic calmness over the whole has been successfully imitated. He only saw the northern boundary, and the parts about Palus Bondii somewhat different from Bond. The divisions in the south-east corner of the nebula, so prominent in the drawings made of late with gigantic telescopes, do not appear so distinct in d'Arrest's refractor as in Bond's. In Markree it is not possible to trace them at all. On this point Rosse's drawing contains more particulars than any that I have seen.

The most complicated drawing of the nebula was published in 1868, by the present Earl of Rosse. D'Arrest found this drawing to be very accurate. The dark channels in Regio Hugeniana are, however, rather broad, and two large spots north of the bright mass too prominent, the boundaries are generally considered too sharp, and the contrast between the stronger and feebler parties rather strong by those accustomed to other telescopes; but it does not appear that the limits to which nebulosity was traced are much farther than in the refractors of Cambridge, United States, and Copenhagen. The feeble streams of nebulosity which connect the θ with the southern ι nebula have been well studied at Birr Castle, while the faint northern branches were more attended to in Cambridge, United States, where Bond first traced the connection with the c nebula. The connection between θ and ι was known to d'Arrest since autumn, 1865.

On Rosse's drawing the east point of the main part is bent somewhat and does not go smoothly over in Proboscis Major. Thus far this agrees with d'Arrest, but the image at present seen in the Markree refractor is more like Bond's figure. D'Arrest evidently gives the almost straight south-eastern outline of Regio Hugeniana too great concavity. Rosse, d'Arrest, and Holden agree well about the part west of Sinus Gentilii. Hereabout the Roman drawing does not correspond to nature at all. Nor are the diagrams of Liapounov and Cooper in accordance with d'Arrest. Now this might arise from the different quality of their telescopes, but it is not unlikely that some change has taken place here, though d'Arrest does not offer this explanation. But he declares Sinus Lamontii and Hemicyclium Liapounovii to be very changeable. The agreement of the different diagrams of Lacus Lassellii is striking; it was remarked already in 1795, by Schröter, and notwithstanding possible fluctuations in brightness, no alteration in the form has taken

[1] From a discussion of his own and W. Struve's observations, Liapounov concluded that three stars of the trapeze were moving with respect to the fourth, the most southern star. An investigation, on the whole confirmative of this, was read by Prof. Nobile, last year, before the Reale Accademia of Naples.

place during the last eighty years. On the whole this constancy in the form d'Arrest considers the principal result of all our studies of this object. The changes, which have been remarked, seem all reduced to mere variations in intensity, but such small alterations may greatly change the impression we get on looking at certain parts of the nebula.

The nebula has of late been well watched at the United States Naval Observatory. Prof. Holden has been hitherto engaged in making micrometric measurements of prominent parts of the nebula and noting the order of brightness of the various masses. He will even attempt a little photometry with the 26-in. refractor. The stars suspected to be variable by O. Struve, are nightly observed. From a provisory discussion of the observations, Holden alludes to changes of short period, and a preliminary sketch of the central part shows that his discoveries in nebular astronomy are likely to rank with those of Newcomb and Hall in other parts of the science. W. D.

AMERICAN GEOLOGICAL SURVEYS

NORTH-WESTERN WYOMING AND YELLOWSTONE NATIONAL PARK [1]

IN a former number of NATURE (vol. xii. p. 265) some account was given of the various independent surveys in progress among the western territories of the United States. Allusion was then made to the unfortunate want of concert among them which had led to a reduplication of the work, and consequently to a struggle at Washington between the different surveying staffs, one fighting for a continuance of power, another for very existence. By the decision adopted by Congress the Engineer Department retained control only of those surveys which might be required for military purposes, while the geographical, geological, and other surveys, carried on for the purpose of exploring new ground and making its features and productions known were to be taken charge of by the Department of the Interior. Such a limitation ought to be sufficient to prevent any future risk of the same tract of country being surveyed twice by different and independent officers. That it was needed became abundantly evident during the time of the contest which was finally settled by Congress. And the present volume furnishes fresh proof of its necessity.

Early in the year 1873 the Engineer Department organised a surveying party to make a military reconnaissance of the north-west of Wyoming territory lying between the Union Pacific Railroad and the line of the Northern Pacific Railroad in Montana. As this department had all along been in the habit of employing civilian geologists, naturalists, botanists, and other scientific observers, Captain Jones, who took command of the expedition, collected a party of nineteen persons, exclusive of a military escort under four officers. This military character which the engineers have given to their reconnaissances, though, perhaps, hardly avoidable, seems with good reason to have been regarded as irritating to the Indians. During the investigation into the question of reduplication of surveys, it was stated by the geologists of the Department of the Interior that they did not wish any escort of soldiers as they were never molested by the Indians, who would have been suspicious of their movements had soldiers accompanied them. Captain Jones, indeed, refers to a large war-party of Sioux Indians which came into Big Horn Valley shortly after he and his expedition had passed out of it, and he seems to think that he made a lucky escape. But the appearance of so large a body of armed men as he commanded within the lands reserved by treaty to the Indians could hardly fail to awaken their distrust and set them in motion.

[1] Report upon the Reconnaissance of North-Western Wyoming, including Yellowstone National Park, made in the summer of 1873, by W. A. Jones, Capt. U.S. Engineers, with Geological Report by Prof. T. B. Comstock. (Washington: Government Printing Office.)

The country passed over in the route lay across the formidable range of rugged snow-capped mountains which rise round the head-waters of the Yellowstone. By some travellers this lofty barrier had been pronounced to be inaccessible, one picturesque observer declaring that "a bird cannot fly over that without taking a supply of grub along." Once across the watershed the expedition descended upon the basin of the Yellowstone, which had already become famous for its wonderful hot springs, and had been pretty fully described and carefully mapped. Indeed when one remembers how much had already been done in the scientific exploration of North-western Wyoming, one is tempted to ask whether the elaborate preparations made by Capt. Jones were really needed. Nearly a half of the geological part of the Report is occupied with a description and discussion of the geyser phenomena of the National Park—a very interesting and important subject, but one which had already been largely treated of, and which does not appear to be quite in its proper place in the midst of a military reconnaissance. Dr. Hayden, who had done so much to make known the structure and the wonders of that region, is cited in the report, but not in such a way as to suggest any adequate notion of the relative importance of his labours and those of Capt. Jones's expedition. The most important geographical point established by the latter traveller was the existence of an easily traversible pass through the mountains between the head of Wind River and the sources of the Yellowstone. He named it Togwotee Pass, and found that though it reaches an elevation of 9,621 feet above the sea, the slopes leading to it are so gentle that a railway might be led through it at a reasonable cost.

Prof. Comstock, who was attached as geologist to the expedition, contributes a series of geological chapters to the Report. They are well written, and show him to be not only a good observer, but one who endeavours to group what he sees round some leading principles in science. In particular he adopts a systematic method of treatment in preference to the order of observation usually followed in such reports. This plan saves his readers at a distance much time and trouble, besides enabling them to grasp the main outlines of his work far more clearly than would be otherwise possible. He begins by giving a general outline of the physical geography of the region, connecting the area examined by the party with the rest of the Rocky Mountain tracts as far as explored by other observers. Availing himself of the previous labours of Hayden, Clarence King, Whitney, and others, he arranges his narrative of the geological history of the region in stratigraphical order, beginning with the most ancient metamorphic or archæan rocks, and leading his readers through the Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, Tertiary, and Post-tertiary systems. In seven interesting chapters Prof. Comstock discusses the questions in dynamical geology suggested by the work of the expedition. In pointing out the evidences for glacial action in North-western Wyoming, he admits that even the hardest rocks fail to show traces of glacier-striation; that in all his journey he had only seen two or three faint scratches approaching the nature of a glacial mark, but which might have been made quite recently. He found, however, on the Wind River plateau long and high ridges composed of huge granite boulders and immense blocks of Silurian and other rocks, with intervening lakes or ponds, and he no doubt correctly regards these features as glacier-moraines. He finds evidence of enormous erosion in recent geological times, and points out the causes now at work in producing rapid disintegration and removal of rock. Among these he mentions the great altitude of the region allowing of the accumulation of large masses of snow, and of the alternate freezing and thawing of the snow by night and day; the steepness of the slopes favouring rapid erosion, and the character of the rocks powerfully influencing alike the amount of